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(54) **Portable respiration apparatus connectable to a stationary gas unit**

Tragbares Beatmungsgerät, das an eine stationäre Gaseinheit anschliessbar ist

Respirateur portable et connectable à une unité de gaz stationnaire

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Description

[0001] The present invention relates to a portable respiration apparatus according to the preamble to claim 1. The invention relates particularly to a portable ventilator (respirator).

[0002] The present invention also relates to a respiration apparatus system.

[0003] Simple types of ventilators (home care ventilators) intended for use in the home are available for many patients in need of limited assisted ventilation. These home ventilators often contain a compressor or fan for generating the required pressure of air supplied to the patient and sometimes even a small oxygen cylinder for enriching the air's oxygen content. Ventilators of this kind are also used in hospitals for e.g. subacute patients and in many developing countries. Utilisation of these ventilators makes it possible to prevent the needless occupation of expensive beds in intensive care.

[0004] One problem with these ventilators is the fact that they are relatively large and heavy, since a relatively large fan/compressor is needed to generate all the pressures that may be needed in treatment, i.e. up to about 10 kPa (100 cm H_2O). They also consume large amounts of energy. When the ventilators are battery-powered, the battery also contributes to increased ventilator weight and bulk. Even if they are transportable, e.g. mainly by being installed on different kinds of wheeled carriers, they are not particularly suitable for being carried by the patient.

[0005] WO 96/11717 discloses a portable ventilator with a rotary drag compressor for generating a gas flow. The ventilator has an inlet for ambient air and an outlet for delivering the gas flow.

[0006] A completely portable respiration apparatus would therefore offer the patient enormous freedom. One such apparatus can be achieved by miniaturising the fan and by limiting the gas pressure the apparatus is able to generate in relation to the available energy (a battery), e.g. by limiting pressure to about 40 to 60 cm H_2O. This pressure is sufficient for most patients in this category, especially patients who do not require supplemental oxygen or only a very small amount of supplemental oxygen (enabling a very small cylinder to last a relatively long time). The fan can then be completely battery-powered, and a smaller (rechargeable) battery will last long enough for the patient to be away from her/his home safely for a few hours, e.g. to go shopping or visit the doctor. When the patient returns home, or the battery needs recharging, the portable respiration apparatus is simply plugged into the nearest source of electrical power, including mains (wall socket) or a car battery. So the patient has almost unlimited mobility when travelling by car.

[0007] It should also be noted that the pressure-generating part of the portable respiration apparatus has a limited supply of energy, not necessarily a limited pressure-generating capacity. Miniaturisation is solely for the purpose of minimising battery size while still achieving a reasonably long period of time in which the portable respiration apparatus is able to run on battery power. When the portable respiration apparatus is used without any other source of energy except the battery for very brief periods of time, the portable respiration apparatus can be allowed to consume more energy and, accordingly, generate a higher pressure.

[0008] However, even greater safety would be desirable to cover every conceivable eventuality in which the supply of energy is limited or when the pressure-generating part of the respiration apparatus is technically restricted to the generation of a particular pressure, e.g. 40 - 60 cm H_2O.

[0009] In the latter instance, there is also the problem of accommodating patients in temporary need of a gas pressure higher than the portable ventilator is able to deliver.

[0010] One way to solve this problem would be to equip each patient with both a conventional home care ventilator and a portable respiration apparatus. However, the patient would then be forced to switch tubing to her/his airways and/or the apparatus as well as program both devices. This arrangement would also be more expensive to society, since both devices would have to be capable of independent operation.

[0011] One objective of the present invention is to achieve a portable respiration apparatus, according to the above, which solves the stated problems.

[0012] Another objective of the invention is to achieve a respiration apparatus system which solves the stated problems.

[0013] The first objective is achieved according to the invention in that the portable respiration apparatus is devised according to the characterising part of claim 1.

[0014] The second objective is achieved according to the invention in that the respiration apparatus system is devised according to claim 6.

[0015] When the portable respiration apparatus is devised so it can be connected to a stationary gas unit, an optimal system, consisting of a portable unit and a stationary unit, is achieved. The patient can easily take the portable unit anywhere and connect it, when necessary, to the stationary unit which contributes sufficient "basic pressure" to enable the portable unit to supply an even higher pressure. Both the units are specifically devised for their respective purposes and can therefore serve as a particularly cost-effective system, compared to the duplication of all functions that would be necessary if two completely separate devices, i.e. a portable and a stationary, had to be used. In principle, the portable unit contains all the control and regulatory functions.

[0016] It would be especially advantageous if the portable unit's inlet were devised so other independent units, such as conventional ventilators, could be connected to it. This can be done at a hospital where such devices are available. There would then be no need for the patient to disconnect from the portable unit in order

to undergo brief supplemental treatment with a ventilator, e.g. to permit the administration of some gas mixture other than ordinary air.

[0017] It should be noted here that "stationary" unit does not refer to a permanently installed device but primarily to a separate pressure-generating unit that could also be portable. However, an interconnected system, i.e. a portable unit and a stationary unit, will always be somewhat bulkier than a portable unit alone. In principle, the portable unit could even be devised so two portable units could be interconnected in order to increase pressure. A patient would therefore be able to have one stationary unit at home, one in the car, one at her/his work place etc. Ambulances, hospital beds etc. would be equipped with stationary units. The patient can then be simply and conveniently transported by different modes of transportation without any interruption in the breathing assistance provided.

[0018] Embodiments of the portable respiration apparatus and respiration apparatus system will be described below in greater detail, referring to the figures in which

FIG. 1 shows one embodiment of the portable respiration apparatus;
FIG. 2 shows a first embodiment of a stationary unit; and
FIG. 3 shows the portable respiration apparatus connected to a second embodiment of a stationary unit.

[0019] A portable respiration apparatus 2 is shown in FIG. 1. A gas channel 4 running through the portable respiration apparatus 2 between an inlet 6 and an outlet 8 carries a flow of air to a patient (not shown) via a system of tubing. The flow and pressure of the gas are generated by a fan 10 (which could also be a turbine). The fan 10 is controlled by a control unit 12 which receives reference values for pressure and flow from setting knobs 14. The fan 10 can be dimensioned to generate a limited peak pressure, e.g. 4-6 kPa (40-60 cm H_2O), enabling the fan to be made small enough for portability. These pressures are fully sufficient for a large percent of patients treated at home and offer them great freedom of movement. Some known turbines are small enough but still capable of generating up to about 13 kPa (130 cm H_2O), sufficient for any application. But energy requirements for the higher pressures would then be so great that an excessively large battery would be needed. Turbines are therefore functionally limited to generating only lower pressures during battery operation.

[0020] In instances in which a higher gas pressure is required, e.g. when the patient's condition takes a temporary change for the worse, a stationary unit can be connected to the inlet 6. A regulatory interface (illustrated with control line 15 from the control unit 12) can also be arranged at the inlet 6. FIG. 2 shows a first embodiment of a stationary unit 16. The stationary unit 16 has a gas channel 18 connecting an inlet 20 to an outlet 22. A fan 24 is arranged in the gas channel 18 to generate a flow of gas and positive pressure to the outlet 22. The fan 24 is controlled by a control unit 26 that receives reference values from control knobs 28 and/or from the portable unit via the control line 30.

[0021] A plurality of versions are possible here. The stationary unit 16 can be dimensioned so it only supplies the "differential pressure" for the portable unit's upper pressure limit, i.e. series connection of the pressure increase, the stationary unit supplying a first pressure increase to a suitable level, e.g. about 6 kPa (60 cm H_2O), and the portable unit supplying a second pressure increase, e.g. about 4 kPa (40 cm H_2O). The end pressure to the patient would then amount to about 7 kPa (70 cm H_2O) (only about 50% of the increase contributed by the stationary unit would be achieved because of losses in the system in series connection).

[0022] Alternately, the stationary unit 16 can be controlled from the portable unit and made to supply the desired flow and pressure itself, the stationary unit being dimensioned to be capable of generating up to e.g. 13 kPa (130 cm H_2O). This can easily be achieved, since the stationary unit does not need to be dimensioned for space reasons in the same way as the portable unit. This also means that it is easier to retain dynamics across the entire pressure range with uncomplicated regulation, something that is not as simple with the series-connection alternative.

[0023] FIG. 3 shows the portable unit 2 connected to a second embodiment of the stationary unit 32. In this instance, the stationary unit 32 consists, in principle, of a regulator that can be set to reduce the pressure of gas from a gas cylinder 34 to an appropriate level. The portable unit 2 can then regulate the flow and end pressure to the patient from this basic pressure. The cylinder 34, which can contain any suitable gas mixture, is connected to the gas regulator 32 by a gas line 36. Ordinary air in particular can be connected.

[0024] In principle, the gas regulator 32 could be replaced with a conventional ventilator or a constant pressure-generating bellows system. Virtually any pressure-generating system can be employed for supplying the portable unit 2 with a basic level of pressure exceeding atmospheric pressure.

[0025] The interchangeability of the stationary unit offers numerous opportunities for making patients more comfortable and devising a rational system for providing acute, subacute and chronic patients with respiratory treatment and help.

[0026] In addition to the obvious benefits in home care, in which patient mobility is greatly improved, the principles of the system with a portable unit and a stationary unit can also be applied to other applications, e. g. the transport of patients who need to be moved a plurality of times before reaching a treatment point at a hospital or the like. A patient can first be provided with a portable unit as respiratory first aid. The portable unit is

connected to a stationary unit when the patient is placed in the ambulance (or some other appropriate vehicle). At the hospital, the portable unit is disconnected from the stationary unit, and the patient is transferred, retaining the portable unit so there is no loss of breathing assistance, to a stretcher for further transportation to a treatment point.

[0027] In principle, the stationary unit can also be battery-powered and transported with the portable unit.

[0028] Another potential application is in anaesthesia where the patient needs breathing assistance during anaesthesia. This can also be performed on the way to the operating room. In principle, the induction of anaesthesia can be commenced during transportation to the hospital, e.g. by intravenous administration of an anaesthetic agent.

Claims

1. A portable respiration apparatus (2) comprising a pressure- and flow-generating unit (10) with an inlet (6) for the intake of gas for generating a gas flow with an upper pressure limit on admitted gas, an outlet (8) for the generated gas flow and a system of tubing for carrying the flow of gas from the outlet (8) to a patient, **characterised in that** the inlet (6) is devised to be connectable to an outlet (22) on a stationary gas unit (16; 32) for supplying air, or some other gas mixture with a predetermined flow and positive pressure, to the inlet (6), whereby a pressure higher than the upper pressure limit can be generated and carried to the patient when the portable respiration apparatus (2) is connected to the stationary gas unit.

2. A portable respiration apparatus according to claim 1, **characterised in that** the pressure- and flow-generating unit (10) comprises a fan, a compressor or a turbine.

3. A stationary gas unit **characterised by** an outlet (22) devised to be connectable to an inlet (6) to a portable respiration apparatus according to claim 1 or 2.

4. A stationary gas unit according to claim 3, **characterised by** a stationary pressure- and flow-generating unit (16) with a inlet (20) opening into ambient air and a fan (24) for generating a pre-defined positive pressure and delivering same to the inlet (6) of the portable respiration apparatus (2).

5. A stationary gas unit according to claim 3, **characterised by** a ventilator or a gas regulator (32), intended for connection to a gas source (34) containing gas under pressure, for delivering a predetermined positive pressure to the inlet (6) of the portable respiration apparatus (2).

6. A respiration apparatus system, **characterised by** the combination of a portable gas unit (2), comprising a pressure- and flow-generating unit (10) for generating a flow of gas with an upper pressure limit, and a stationary gas unit (16; 32) designed to deliver a flow of gas at a predetermined pressure, the portable gas unit (2) being devised to function as an independent respiration apparatus comprising an inlet (6) connectable to an outlet (22) of the stationary gas unit (16; 32) so a gas pressure higher than the upper pressure limit can be generated.

7. A respiration apparatus system according to claim 6, **characterised in that** the stationary gas unit comprises a stationary pressure- and flow-generating unit (16) for generating a flow of gas at the predetermined pressure and delivering same to the portable gas unit when the portable gas unit (2) and the stationary gas unit (16) are interconnected.

8. A respiration apparatus system according to claim 6, **characterised in that** the stationary gas unit comprises a ventilator (32), intended for connection to a source of gas (34) under pressure, whereby a flow of gas at the predetermined pressure can be delivered to the portable gas unit (2) when the stationary gas unit (32) and the portable gas unit (2) are interconnected.

9. A respiration apparatus system according to claim 6, **characterised in that** the stationary gas unit comprises a pressure regulator (32), intended for connection to a source of gas (34) under pressure, whereby a flow of gas at the predetermined pressure can be delivered to the portable gas unit (2) when the stationary gas unit (32) and the portable gas unit (2) are interconnected.

10. A respiration apparatus system according to claim 6, **characterised in that** the stationary gas unit (16; 32) is devised to generate the total flow of gas at the end pressure for delivery to the patient, and the pressure- and flow-generating unit (10) is disconnected when the stationary gas unit (16; 32) and the portable gas unit (2) are interconnected.

Patentansprüche

1. Ein tragbares Beatmungsgerät (2) mit einer Druck- und Flusserzeugungseinheit (10) mit einem Einlass (6) zur Aufnahme von Gas zum Erzeugen eines Gasflusses mit einer oberen Druckgrenze des aufgenommenen Gases, einem Auslass (8) für den erzeugten Gasfluss und einem System von Leitungen zum Transportieren des Gasflusses von dem Aus-

lass (8) zu einem Patienten, **dadurch gekennzeichnet, dass** der Einlass (6) ausgebildet ist, an einen Auslass (22) einer stationären Gaseinheit (16; 32) anschließbar zu sein zur Zufuhr von Luft oder irgend einer anderen Gasmischung mit einem vorbestimmten Fluss und positivem Druck an den Einlass (6), wobei ein höherer Druck als der der oberen Druckgrenze erzeugt werden und dem Patienten zugeführt werden kann, wenn das tragbare Beatmungsgerät (2) an die stationäre Gaseinheit angeschlossen ist.

2. Ein tragbares Beatmungsgerät gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Druck- und Flusserzeugungseinheit (10) ein Gebläse, einen Kompressor oder eine Turbine enthält.

3. Eine stationäre Gaseinheit, **gekennzeichnet durch** einen Auslass (22), der ausgebildet ist, an den Einlass eines tragbaren Beatmungsgeräts gemäß Anspruch 1 oder 2 anschließbar zu sein.

4. Eine stationäre Gaseinheit gemäß Anspruch 3, **gekennzeichnet durch** eine stationäre Druck- und Flusserzeugungseinheit (16) mit einem Einlass (20), der in die Umgebungsluft öffnet, und einem Gebläse (24) zum Erzeugen eines vorbestimmten, positiven Druckes und zur Abgabe desselben an den Einlass (6) des tragbaren Beatmungsgeräts (2).

5. Eine stationäre Gaseinheit gemäß Anspruch 3, **gekennzeichnet durch** einen Ventilator oder Gasregler (32), vorgesehen zum Anschließen an eine Gas unter Druck enthaltende Gasquelle (34) zur Abgabe eines vorbestimmten positiven Drucks an den Einlass (6) des tragbaren Beatmungsgeräts (2).

6. Ein Beatmungsgerätsystem **gekennzeichnet durch** die Kombination einer tragbaren Gaseinheit (2) mit einer Druckund Flusserzeugungseinheit (10) zum Erzeugen eines Gasflusses mit einer oberen Druckgrenze und einer stationären Gaseinheit (16; 32), die ausgebildet ist, einen Gasfluss mit einem vorbestimmten Druck abzugeben, wobei die tragbare Gaseinheit (2) ausgebildet ist, um als ein unabhängiges Beatmungsgerät zu funktionieren, das einen Einlass (6), der an einen Auslass (22) der stationären Gaseinheit (16; 32) anschließbar ist, aufweist, so dass ein höherer Gasdruck als die obere Druckgrenze erzeugt werden kann.

7. Ein Beatmungsgerätsystem gemäß Anspruch 6, **dadurch gekennzeichnet, dass** die stationäre Gaseinheit eine stationäre Druck- und Flusserzeugungseinheit (16) zum Erzeugen eines Gasflusses mit einem vorbestimmten Druck aufweist und zum Abgeben desselben an die tragbare Gaseinheit, wenn die tragbare Gaseinheit (2) und die stationäre Gaseinheit (16) verbunden sind.

8. Ein Beatmungsgerätsystem gemäß Anspruch 6, **dadurch gekennzeichnet, dass** die stationäre Gaseinheit einen Ventilator (32) aufweist, vorgesehen für den Anschluss an eine Gasquelle (34) unter Druck, wobei der Gasfluss bei dem vorbestimmten Druck an die tragbare Gaseinheit (2) abgegeben werden kann, wenn die stationäre Gaseinheit (32) und die tragbare Gaseinheit (2) verbunden sind.

9. Ein Beatmungsgerätsystem gemäß Anspruch 6, **dadurch gekennzeichnet, dass** die stationäre Gaseinheit einen Druckregler (32) aufweist, vorgesehen zum Anschluss an eine Gasquelle (34) unter Druck, wobei der Gasfluss bei dem vorbestimmten Druck an die tragbare Gaseinheit (2) abgegeben werden kann, wenn die stationäre Gaseinheit (32) und die tragbare Gaseinheit (2) verbunden sind.

10. Ein Beatmungsgerätsystem gemäß Anspruch 6, **dadurch gekennzeichnet, dass** die stationäre Gaseinheit (16; 32) ausgebildet ist, den Gesamtgasfluss bei dem Enddruck zur Abgabe an den Patienten zu erzeugen und die Druck- und Flussergzeugungseinheit (10) abgekoppelt ist, wenn die stationäre Gaseinheit (16; 32) und die tragbare Gaseinheit (2) verbunden sind.

Revendications

1. Dispositif (2) portatif de respiration comportant une unité (10) de production de pression et de débit, ayant une entrée (6) pour l'admission de gaz pour produire un écoulement gazeux avec une limite de pression supérieure sur du gaz admis, une sortie (8) pour le débit de gaz produit et un système de tubes pour acheminer le courant de gaz de la sortie (8) vers un patient, **caractérisé en ce que** l'entrée (6) est conçue pour pouvoir être reliée à une sortie (22) sur une unité (16 ; 32) stationnaire de gaz pour fournir de l'air, ou un autre mélange gazeux avec une pression positive et un écoulement déterminés à l'avance, à l'entrée (6), une pression plus élevée que la limite de pression supérieure pouvant ainsi être produite et acheminée au patient lorsque le dispositif (2) de respiration portatif est relié à l'unité stationnaire de gaz.

2. Dispositif portatif de respiration suivant la revendication 1, **caractérisé en ce que** l'unité (10) de production de pression et de débit comporte un ventilateur, un compresseur ou une turbine.

3. Unité stationnaire de gaz, **caractérisée par** une sortie (22) conçue pour pouvoir être connectée à

une entrée (6) à un dispositif de respiration portatif suivant la revendication 1 ou 2.

4. Unité stationnaire de gaz suivant la revendication 3, **caractérisée par** une unité (16) de production de débit et de pression stationnaire, ayant une entrée (20) débouchant dans l'air ambiant et un ventilateur (24) pour produire une pression positive prédéfinie et fournir cette dernière à l'entrée (6) du dispositif (2) de respiration portatif.

5. Unité stationnaire de gaz suivant la revendication 3, **caractérisée par** un ventilateur ou un régulateur (32) de gaz, destiné à être connecté à une source (34) de gaz contenant du gaz sous pression, pour délivrer une pression positive déterminée à l'avance à l'entrée (6) du dispositif (2) de respiration portatif.

6. Système formant dispositif de respiration, **caractérisé par** la combinaison d'une unité (2) de gaz portatif, comportant une unité (10) de production de débit et de pression pour produire un débit gazeux avec une limite de pression supérieure, et une unité (16 ; 32) stationnaire de gaz conçue pour fournir un écoulement gazeux à une pression déterminée à l'avance, l'unité (2) portative de gaz étant conçue pour fonctionner en tant qu'un dispositif de respiration indépendant comportant une entrée (6) pouvant être reliée à une sortie (22) de l'unité (16 ; 32) stationnaire de gaz de sorte qu'une pression du gaz supérieure à la limite de pression supérieure peut être produite.

7. Système formant dispositif de respiration suivant la revendication 6, **caractérisé en ce que** l'unité stationnaire de gaz comporte une unité (16) de production de débit et de pression stationnaire pour produire un débit gazeux à la pression déterminée à l'avance et délivrer ce dernier à l'unité portative de gaz lorsque l'unité (2) portative de gaz et l'unité (16) stationnaire de gaz sont interconnectées.

8. Système formant dispositif de respiration suivant la revendication 6, **caractérisé en ce que** l'unité stationnaire de gaz comporte un ventilateur (32), destiné à être connecté à une source de gaz (34) sous pression, un débit gazeux à la pression déterminée à l'avance pouvant ainsi être fourni à l'unité (2) portative de gaz lorsque l'unité (32) stationnaire de gaz et l'unité (2) portative de gaz sont interconnectées.

9. Système formant dispositif de respiration suivant la revendication 6, **caractérisé en ce que** l'unité stationnaire de gaz comporte un régulateur (32) de pression, destiné à la connexion à une source (34) de gaz sous pression, un débit gazeux à la pression déterminée à l'avance pouvant ainsi être fourni à l'unité (2) portative de gaz lorsque l'unité (32) stationnaire de gaz et l'unité (2) portative de gaz sont interconnectées.

10. Système de dispositif de respiration suivant la revendication 6, **caractérisé en ce que** l'unité (16 ; 32) stationnaire de gaz est conçue pour produire le débit total de gaz à la pression d'extrémité pour délivrance au patient, et l'unité (10) de production de pression et de débit est déconnectée lorsque l'unité (16 ; 32) stationnaire de gaz et l'unité (2) de gaz portative sont interconnectées.

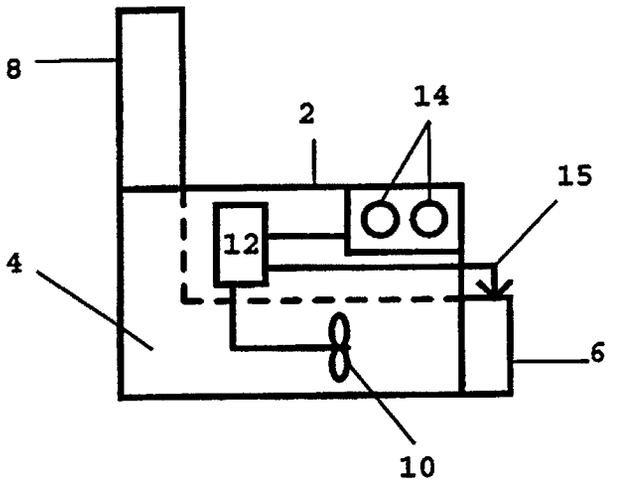

FIG. 1

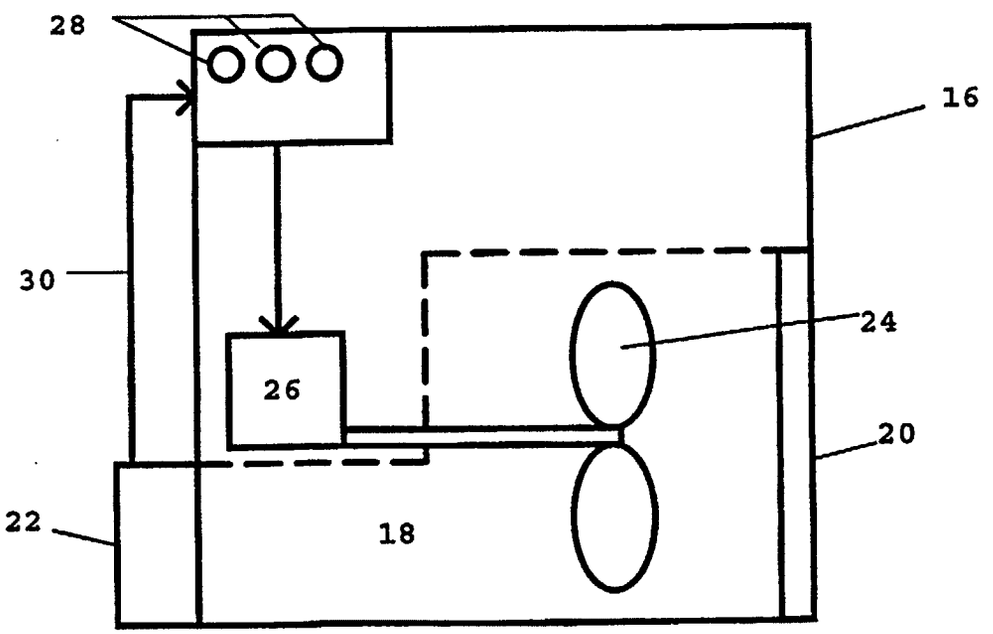

FIG. 2

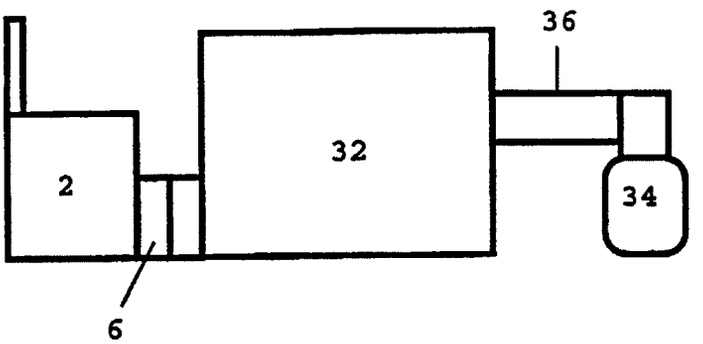

FIG. 3